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NEBRASKA

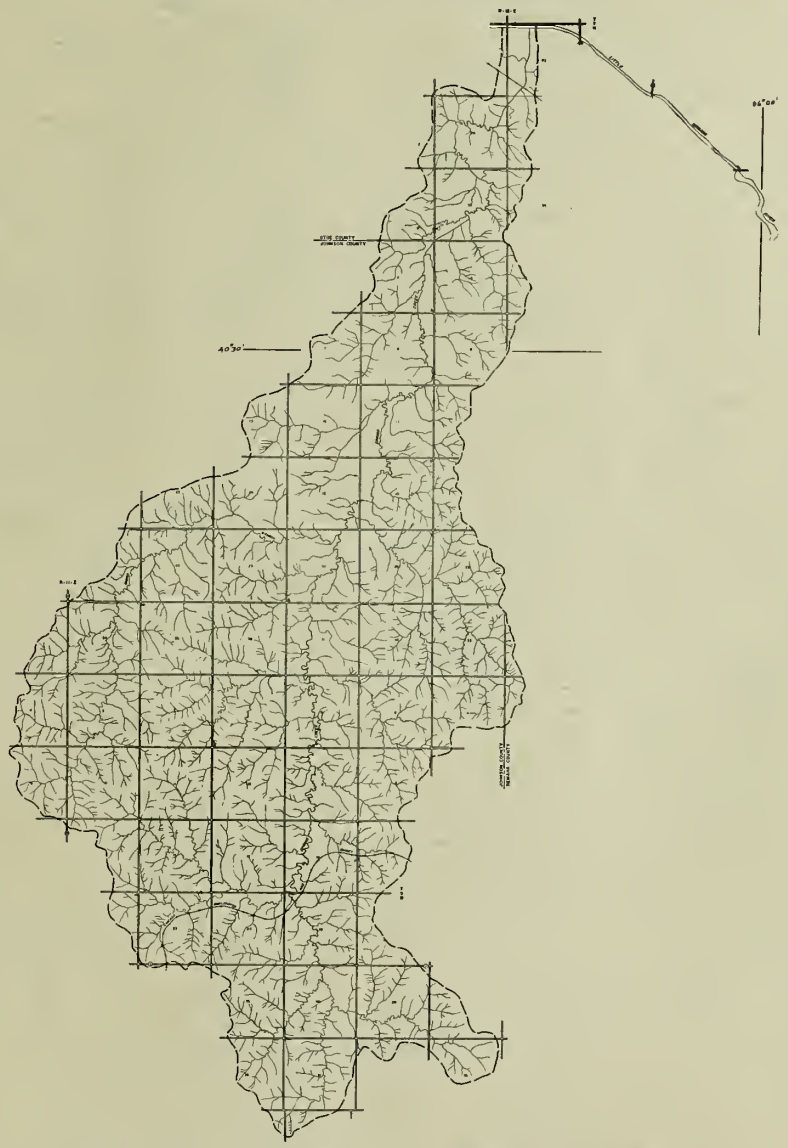
WATERSHED WORK PLAN

FOR

WATERSHED PROTECTION

AND

FLOOD PREVENTION



SPRING CREEK WATERSHED

JOHNSON, OTOE and NEMAHA COUNTIES, NEBRASKA

JUNE, 1964

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WATERSHED WORK PLAN

SPRING CREEK WATERSHED

Johnson, Otoe, and Nemaha Counties, Nebraska

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act. (Public Law 566, 83d Congress, 68 Stat. 666) as amended.

Prepared By: Johnson County Soil and Water Conservation District; Otoe County Soil and Water Conservation District; Nemaha County Soil and Water Conservation District; and Spring Creek Watershed Conservancy District

With Assistance By:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

State of Nebraska Soil and Water Conservation Commission

June, 1964

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WATERSHED WORK PLAN

SPRING CREEK WATERSHED

Johnson, Otoe, and Nemaha Counties, Nebraska

June, 1964

SUMMARY OF PLAN

Spring Creek Watershed is 33,465 acres in size and is located in Johnson, Otoe, and Nemaha Counties, Nebraska, approximately 40 miles southeast of Lincoln, Nebraska.

The sponsors are the Johnson, Otoe, and Nemaha County Soil and Water Conservation Districts and the Spring Creek Watershed Conservancy District. The Soil Conservation Service and Forest Service, agencies of the United States Department of Agriculture, gave technical assistance in preparing this plan. The State of Nebraska Soil and Water Conservation Commission furnished funds and personnel to assist in collecting and processing field data.

Watershed problems consist of floodwater, grade stabilization and erosion damages. The project will provide the following protection: Average annual floodwater damages to crops and pastures will be reduced 61 percent and 3,398 acres of upland will benefit by base grade stabilization. Conservation treatment will be established on 7,350 acres of cropland; 5,140 acres of grassland; 57 acres of miscellaneous land and 95 acres of woodland.

Average annual reduction in damages to crops and pasture will amount to $20,740.

Structural works of improvement will consist of seven floodwater retarding structures and 21 grade stabilization structures to be installed over a seven-year period.

Estimated cost of installing the project is $1,285,000. Public Law 566 cost share is $829,400, of which $41,900 is for technical assistance to speed-up establishment of land treatment measures and $787,500 is for installing the structural measures. The cost share provided by local interests is $455,600. The value of land treatment applied to date is $522,600. Farmers will establish additional land treatment during the installation of the project at a cost of $301,700, for a total of $824,300. Immediately after the local people filed their application with the State of Nebraska Soil and Water Conservation Commission in May, 1961 they began accelerating the application of land treatment. Funds provided for technical assistance for land treatment under current Soil Conservation and Forest Service programs amount to $34,600 during the installation period.

The sponsors will operate and maintain the structural measures after installation at an average cost of $2,315 annually. Funds, materials, and

labor for these purposes will be furnished by the watershed conservancy district, as provided for by Nebraska law.

Estimated average annual benefits from the installation of structural measures are $54,076. Average annual equivalent costs of structural measures are $38,400. The ratio of benefit to cost is 1.4 to 1.

DESCRIPTION OF THE WATERSHED

Physical Data

Spring Creek Watershed contains 52.3 sq. mi. or 33,465 acres and has 31,000 acres in Johnson County; 2,200 acres in Otoe County; and 265 acres in Nemaha County. Spring Creek begins in the eastern part of Johnson County and flows north to the Little Nemaha River. It enters the river about three miles above Talmage, Nebraska. The watershed is approximately 15 miles long and varies from less than one to seven miles wide.

Topography varies from nearly level upland divides to moderately steep rolling hills along the more deeply entrenched streams. Surface elevations range from about 960 feet at the mouth to 1,315 feet on the divide. The relief is 355 feet. Average main channel grade varies from seven feet per mile in the lower two-thirds to twelve feet per mile in the upper one-third.

Predominant upland soils series are Sharpsburg, Pawnee, Wymore, and Shelby. Valley and floodplain soils are alluvial silt and silty clay loams of the Colo and Hobbs series.

About 38 percent of the area is in tame and native grass and is rated as a fair hydrologic condition. Principal crops are corn, milo, wheat, soybeans, alfalfa, and clover.

Woodland is located along Spring Creek and its larger tributaries. Approximately 60 percent of the woodland acres are located close to farmsteads and their use is for pasture. About 40 percent is isolated, or for some other reason is being used for timber production. With few exceptions the woodlands are on fertile soil. Total woodland acres owned by any one individual is quite small. Species commonly found are black walnut, soft maple, bur oak, cottonwood, ash, elm, and locust. Many stands are fully stocked but are lacking in quality and species composition.

Most of the precipitation is from high intensity and short duration thunderstorms. Average annual precipitation at Tecumseh, two miles southwest of the watershed, is 31.55 inches. Maximum recorded precipitation was 49.57 inches in 1951. The minimum was 19.59 inches in 1890. Maximum temperature recorded was 112° and the minimum -30°. The average frost-free period is April 25 to October 7. Average length of the growing season is 165 days, with 73 percent of the rainfall occurring during that time.

An adequate supply of water is available for domestic use.

Economic Data

Economy of the watershed is based on dryland agriculture. The estimated acreage and percentage distribution of present land use is as follows:

Land Use	Bottomland		Upland	
	Acres	Percent	Acres	Percent
Cropland	1,836	60	21,254	70
Pastureland	123	4	4,227	14
Rangeland	765	25	2,582	8
Woodland 1/	275	9	60	-
Miscellaneous	61	2	2,282	8
Total	3,060	100	30,405	100

1/ There are no lands under the jurisdiction of the Forest Service in this watershed.

Woodlands have received very poor management in the past. Any tree able to establish itself has been allowed to grow resulting in stands of little economic importance. These sites are rated "very high" potential in terms of tree growth. Profitable species such as black walnut do well and marketing is no problem. A stand of well-managed walnut trees on these favorable sites will increase in value at the rate of $1 per tree per year.

Scattered small areas would lend themselves well to wildlife habitat development.

The majority of farming operations are a cash-grain cattle-feeding enterprise. Approximately 40 percent of the farm income is from sale of crops. The balance is from sale of livestock, poultry, and their products. Grains in excess of local feeding requirements are marketed at Tecumseh, Syracuse, Talmage, and Cook. Markets for livestock are at Omaha, Nebraska and St. Joseph and Kansas City, Missouri.

An estimated 365 people live in the watershed. Federal Highway No. 136 and State Highway No. 50 pass through the area. County and township roads bound almost every section and two railroads traverse the area: The Missouri Pacific across the lower end and Chicago, Burlington, and Quincy across the upper portion.

There are approximately 165 farming units, wholly or partially within the watershed. They vary in size from 160 to 480 acres. The average unit

contains 265 acres with an estimated value, including buildings, of $30,700. Average market value per acre is $90 for upland and $200 for bottomland.

WATERSHED PROBLEMS

Floodwater Damage

Floodwater damages to crops, pastures, other agricultural properties, roads and bridges are the principal watershed problems. These damages are generally associated with storms which occur three times per year. These flood-producing storms occur most frequently during June and early July when crops are susceptible to damage. Approximately 3,060 acres of crops and pastures are subject to inundation by a 100-year frequency storm event. About 2,330 acres are flooded by the four-year frequency storm. This land is valued at $200 per acre.

Agricultural properties damaged by flood water include fences, farm buildings and machinery.

There are 3.5 miles of state, county, and township roads and 28 bridges and culverts subject to damage. Flood damage to roads consists of removal of surface materials and erosion of fills. Losses to bridges reflect an increased maintenance and replacement cost that is directly attributed to flood waters.

Flood damage inventories made by local people show 1,897 acres of crop and pasture lands flooded by the storm of July 9, 1958. The order by magnitude of damages were (1) crop and pasture; (2) roads and bridges; (3) agricultural properties, such as fences, farm machinery, livestock and buildings; and (4) land damage from floodplain scour and sediment deposition. The sponsors' estimate of damages resulting from this storm was $99,600. This flood was determined to be about a 25-year frequency event.

Flood hazard has prevented the most profitable use of the floodplain. The most hazardous areas have remained in cool season grasses and sparse timber and are utilized as pastures.

Stream channels become choked to various degrees with limbs, branches, and even entire trees. A major source of this debris comes from trees undercut by the stream. Also contributing are areas of woodland which are not harvested or managed.

A vigorous, well-managed woodland has a great capacity for retarding erosion and reducing peak runoff. Grazing seriously impairs this capacity through soil compaction and the loss of humus and litter. Grazing of woodlands is a common practice in this watershed. The area is within a rural fire district and woodland fire protection appears adequate.

Sediment Damage

Flooding deposits minor amounts of sediment on some portions of the floodplain and in roadside ditches increasing maintenance cost. Under

present conditions, approximately 60,000 tons of sediment is delivered at the mouth of Spring Creek annually.

Erosion Damage

Sheet erosion accounts for approximatley 70 percent of the sediment movement within the watershed. Gully erosion is responsible for 20 percent, with roadside erosion 10 percent. The absence of stable base grades in 72 areas has prevented the installation and/or maintenance of land treatment measures. Most of these areas are seriously gullied to considerable depth with active overfalls. Some areas are so deeply gullied that they will require mechanical measures to reduce channel depth before vegetative outlets can be installed or maintained. In these cases landowners are being denied benefits that would accrue from such measures as terraces, contour farming, and waterway development. Streambank erosion is confined primarily to the outside banks of the sharper meanders.

Floodplain scour damages, especially in the form of scour channels, have resulted in reduced production from 10 to 65 percent on 208 acres of land.

PROJECTS OF OTHER AGENCIES

The U. S. Army Corps of Engineers is presently investigating the possible need for improvements for flood control and allied purposes in the Little Nemaha River Basin.

BASIS FOR PROJECT FORMULATION

The application included an area in the lower portion of the watershed which was a separate hydrologic unit known as the Talmage area. As planning progressed it was found that the problems in this area consisted solely of grade stabilization. These gullies are not active enough at this time to justify structural measures so the area was deleted from the plan by the sponsors.

Objectives of the sponsoring local organizations are to install a project which will:

1. Reduce floodwater damage to farmsteads, cropland, pasture, fences, roads and bridges.
2. Establish base grades for the installation and/or maintenance of land treatment measures.
3. Reduce sediment damage to bottomland, roads, drainage ways, and reservoirs.
4. Reduce scour damage to bottomland.
5. Reduce land damage by sheet and gully erosion.

Official action was taken by the watershed board of directors accepting the level of protection offered by this system of structures.

Topography limits the number of sites available for floodwater control. Sites were selected that would reservoir as much drainage area as possible and affect the least number of roads, farmsteads, utilities, and cropland.

Grade stabilization structures were located to control active overfalls and to establish base grades for the installation and/or maintenance of land treatment measures.

A greater reduction in average annual damages would require moving the structures downstream. This would affect roads, farmsteads, or pipelines and is unacceptable to the local sponsors.

WORKS OF IMPROVEMENT TO BE INSTALLED

The project consists of conservation treatment to 7,350 acres of cropland; 5,140 acres of grassland; 57 acres of miscellaneous land; 95 acres of woodland and the installation of seven floodwater retarding structures and 21 grade stabilization structures. (Table 1 and Project Map, Figure 4).

Land Treatment Measures

The objective of the land treatment phase is to use each acre within its capabilities and to treat it according to its needs. The establishment of conservation practices will reduce erosion, sediment production, and floodwater damage.

Since making application under Public Law 566 local people have accelerated the installation of land treatment. This land treatment is included in table 1A under the column "Applied to Date". Also included on this table is the amount of land treatment to be applied after the installation of the project. All land treatment measures will be maintained by the farmers.

Conservation measures for cropland include conservation cropping systems, contour farming, grassed waterways, gradient terraces, grade stabilization structures, diversions, and range seeding. These practices are defined as follows:

Conservation Cropping System: Growing crops in combination with needed cultural and management measures. Cropping systems include the use of rotations that contain grasses and legumes, as well as sequences in which the desired benefits are achieved without the use of such crops.

Contour Farming: Conducting farming operations on sloping, cultivated land in such a way that plowing, land preparation, planting, and cultivation are done on the contour.

Grassed Waterway or Outlet: A natural or constructed waterway or outlet shaped or graded and established in suitable vegetation as needed for the safe disposal of runoff from a field, diversion, terrace, or other structure.

Gradient Terrace: An earth embankment or a ridge and channel constructed across the slope at a suitable spacing and with an acceptable grade.

Grade Stabilization Structure: A structure such as a drop inlet, chute, or drop installed in a watercourse to stabilize the grade. Usually requires special design, and may include floodwater detention capacity.

Diversion: A channel with a supporting ridge on the lower side constructed across the slope.

Range Seeding: Establishing adapted native grasses or species.

Cropland will be considered to meet the requirements of adequate treatment when these land treatment measures are installed:

1. Land Capability Class I (level to nearly level)

    a. Conservation cropping systems with few restrictions.

2. Land Capability Class II (slightly sloping)

    a. Grassed waterways, terraces, contour farming, diversions, and a conservation cropping system with few and moderate restrictions.

3. Land Capability Classes III and IV (moderately sloping)

    a. Grassed waterways, terraces, contour farming, diversions, and a conservation cropping system with moderate restrictions.

    b. Range seeding.

Conservation measures for grassland include grade stabilization structures, pasture proper use, range seeding, and range proper use.

Pasture Proper Use: Grazing pastureland at a rate that will maintain grasses and legumes of high quality by adjusting the stocking rates or season of use to favor maximum growth and survival.

Range Proper Use: Grazing rangelands at an intensity which will maintain adequate cover for soil protection and maintain or improve the quantity and the quality of desirable vegetation. Graze about half and leave about half of the annual growth.

Grassland will be considered to meet the requirements of adequate treatment when these land treatment measures are installed:

1. Land Capability Class III (moderately sloping)

    a. Pasture proper use.

    b. Range proper use.

    c. Grade stabilization structure.

2. Land Capability Classes IV and VI

    a. Pasture proper use.

    b. Range seeding and range proper use.

    c. Grade stabilization structure.

The conservation measure for critical areas included in miscellaneous land is critical area planting.

Critical Area Planting: Stabilizing silt-producing and severely eroded areas by establishing vegetative cover.

Critical areas will be considered to meet the requirements of adequate treatment when this measure is installed.

1. All Land Capability Classes

    a. Critical area plantings.

The conservation measures for woodland are forest protection, forest management practices and forestation.

Forest Protection: Livestock exclusion by fencing, if necessary. Exclude livestock as the situation demands so as to cause minimum damage to the hydrologic condition of the site.

Forest Management Practices: The growing of trees as a crop with needed cultural and management practices. Proper forest management practices are designed to eliminate undesirable competition, improve stand composition and improve the quality of the timber produced. Such practices contribute to obtaining optimum watershed protection and economic returns.

Forestation: Tree planting to bring thinly stocked woodlands to a proper level of production and watershed protection and to change composition to the desired tree species.

Woodland will be considered to meet the requirements of adequate treatment when these land treatment measures are installed.

1. All Land Capability Classes

    a. Forest protection.

    b. Forest management practices.

    c. Forestation.

Consideration, within the limits of project authorization, will be given to design and construction of practices which will alleviate the mosquito problem associated with the project development.

Structural Measures

Seven floodwater retarding structures and 21 grade stabilization structures are needed to provide the agreed level of protection. The estimated cost of installing the seven floodwater retarding structures is $599,000 and the 21 grade stabilization structures is $307,800. (Table 2).

Floodwater retarding structures will control runoff from 39 percent of the drainage area. They will have storage capacity to detain runoff from a four percent chance storm event without operation of the emergency spillway. They will provide floodwater detention storage of 2,276 acre feet. (Figure 1 and Table 3).

Provisions will be made in the floodwater retarding structures for a 50-year sediment-storage estimated to be 1,560 acre feet. Embankments will be rolled earth and seeded to perennial grasses. Principal spillways will be specially designed, closed conduits through the embankments to discharge the detention volume in less than four days. The crest of the risers will be at the sediment pool elevation at the dam. Emergency spillways will be earthen, seeded to perennial grasses, and designed to carry flows at safe velocities. A general plan and cross section of a typical retarding structure is shown in Figure 1.

Land stabilization problem areas require base grade stabilization. These will be controlled by drop inlet or steel and concrete drop spillway structures designed for a 25-year frequency storm. A general plan and cross section of these structures is shown in Figures 2 and 3. Diversions are planned with grade stabilization structures 6-2 and 6-4. These diversions are needed to support land treatment measures.

Four grade stabilization structures will be modified by increasing the total top width to 26 feet. This is considered adequate for a roadway. The increased top width is 12 feet for structure 6-1 and 14 feet for structures 4-1, 7-1, and 9-6.

EXPLANATION OF INSTALLATION COSTS

Total project costs include cost of installing structural measures for waterflow control, land stabilization and land treatment measures for watershed protection. (Table 1).

Funds estimated to be needed by years for installation of structures are:

	Public Law 566	Other
First Fiscal Year	$ 83,300	$ 9,500
Second Fiscal Year	121,900	13,700
Third Fiscal Year	108,800	23,300
Fourth Fiscal Year	100,800	13,100
Fifth Fiscal Year	76,200	14,400
Sixth Fiscal Year	142,900	21,400
Seventh Fiscal Year	153,600	23,900
Total Structure Cost	$787,500	$119,300

Land Treatment Measures

Estimated future installation costs for land treatment are $301,700. The cost, as experienced by landowners and operators in applying land treatment

measures, was used to estimate future installation costs. It includes the value of cost-sharing assistance to be received under other programs.

Technical assistance costs include the value of time, travel, and other expenditures in developing basic conservation plans, laying out practices, and supervising installation of these measures.

Structural Measures

Cost of installing structural measures includes construction, installation services, administration of contracts, and land, easements, and rights-of-way.

Unit values for estimating construction costs are similar to 1963 contract costs. An 11 percent contingency allowance is included. Construction cost includes funds for vegetating and fencing embankments and emergency spillways.

Costs for installation services are based on current costs of constructing similar structures. Funds are provided for foundation and embankment investigations. Values of land, easements, and rights-of-way include the cost of construction permits and sponsors' estimate of cost to them for easements and flowage rights for structural measures.

EFFECTS OF WORKS OF IMPROVEMENT

Application of land treatment measures will benefit all farms within the watershed. Waterflow control measures will provide reductions in floodwater damage to 52 farms that lie below these measures. Grade stabilization structures will provide reduction in erosion damage to 61 beneficiaries.

Sediment production will be reduced 46 percent as the result of additional land treatment, improved cropping systems, expected changes in land use, and the addition of 21 grade stabilization structures. Floodplain scour damages will be reduced 51 percent. This reduction accounts for a decrease in acres affected and severity of damage.

Installation of the grade stabilization structures will eliminate severe gully erosion damage to about 516 acres of good productive land in the next fifty years. In addition, the installation of these measures will make it possible for landowners to install and maintain such land treatment as terraces, contour farming, and waterways on about 2,882 acres.

Average annual floodwater damage to crops and pastures under present conditions occurs over an area of approximately 3,060 acres. The project will reduce these damages by 61 percent. Land treatment measures account for six percent of this reduction. The project will also reduce the area inundated by the four-year frequency storm event from 2,254 acres to 1,602 acres or by 29 percent.

Abatement of hazards to fences, farm buildings, and driveways will enable farmers to repair or replace these properties at less expense.

Benefits will accrue to 3.46 miles of roads and 28 bridges. Damages to transportation facilities will be reduced 71 percent.

Indirect benefits occur as a reduction in past damages resulting from interruption of transportation, communications, and public utilities.

Reduction in frequencies of floods will permit conversion of 57 acres presently in woody pastures to cropland. This will occur only in areas adjacent to the main channel where these reductions are significant.

Secondary benefits stemming from the project will accrue within its immediate zone of influence. These benefits are from the transporting, processing, and marketing of those goods and services that produce the primary benefits and from the supplying of additional materials.

The project will help stabilize the agricultural economy of the watershed. Production will be enhanced providing more marketable items and assuring a greater need for agricultural supplies. Residents of the watershed will have an improved attitude of well being.

PROJECT BENEFITS

Flood prevention benefits from the project are estimated at $61,316. The following table lists monetary benefits that are derived from significant items:

Items	Average Annual Benefits
Agricultural	
Crop and Pasture	$20,740
Other Agricultural	2,480
Nonagricultural	
Road and Bridge	10,680
Erosion	
Floodplain Scour	1,220
Gullies	5,290
Indirect	3,760
Changed Land Use	1,000
Secondary	2,770
Conservation Treatment Benefits	13,376
Total Average Annual Benefits	$61,316

Total application of additional land treatment measures will have a major effect in reducing sediment production and will provide $7,240 annually in flood prevention benefits. The structural measures account for $54,076.

Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.

COMPARISON OF BENEFITS AND COSTS

Estimated average annual cost of the structural measures is $38,400. These structural measures, when operational, are expected to produce average annual primary benefits of $51,306. The ratio of primary benefits to costs is 1.3 to 1.

Total average annual structural benefits are expected to be $54,076. The ratio of these benefits to costs is 1.4 to 1, as shown in Table 6.

PROJECT INSTALLATION

The work plan proposes a seven-year period for installation of the project.

Land Treatment Measures

Land treatment measures will be established on the land by farm owners and operators in cooperation with the Johnson, Nemaha and Otoe County Soil and Water Conservation Districts.

Technical assistance will be provided by technicians of the Soil Conservation Service and the State Extension Forester in cooperation with the U. S. Forest Service.

The Extension Service will assist with the educational phase of the project. Local farm meetings, tours, radio and press releases will be used to inform landowners and operators and the general public about the project.

The Farmers Home Administration will encourage borrowers to cooperate in project activities and will provide information on loans available for conservation work.

The governing body of the Johnson County Soil and Water Conservation District will work with the Johnson County Agricultural Stabilization and Conservation Committee to provide cost-sharing funds to accelerate application of conservation practices. Emphasis will be given to helping farmers install land treatment which will be effective in attaining project objectives.

The Board of Supervisors of the Johnson County Soil and Water Conservation District and directors of the conservancy district will schedule meetings and arrange for individual contact to encourage landowners and operators to adopt and apply soil and water conservation measures. They will confer with and enlist the assistance of Johnson county and township officials in establishing conservation measures on roadways.

Structural Measures for Flood Prevention

The Spring Creek Watershed Conservancy District, organized under Nebraska statutes, will be the contracting agency for the construction of structural measures. They have been authorized by the other sponsoring organizations to act for them in performing this duty. This will include appointing a contracting officer to perform the contracting duties for the board of directors.

The Conservancy District will acquire necessary land, easements, and rights-of-way for works of improvement. All powers granted them by the state will be used, if necessary, to achieve project objectives. The directors have contacted the owners of property upon which works of improvement are to be installed. Most have agreed that an amicable settlement can be reached. The Conservancy District will enter into a county-district cooperative agreement with the Johnson County Commissioners prior to the signing of project agreements for the grade stabilization structures that are located on county roads (4-1, 6-1, 7-1, and 9-6).

Technicians of the Soil Conservation Service will assist in planning, design, preparation of specifications, supervision of construction, preparation of contract estimates, making final inspections, execution of certificates of completion, and performing other related duties for the establishment of the planned measures for flood prevention.

The Nebraska Department of Health will provide technical assistance on the prevention and control of mosquitoes upon request by sponsoring local organizations.

Sponsoring local organizations have developed a plan for application of land treatment measures and securing land, easements, and rights-of-way for project improvements. This plan lists priorities for installation of structural works. It sets the approximate date easements for structural sites are to be recorded and the required land treatment established. The following table summarizes their plan:

Year	Record easements for and meet minimum requirements for establishment of land treatment above
First Year	One floodwater retarding structure and three grade stabilization structures.
Second Year	One floodwater retarding structure and three grade stabilization structures.
Third Year	One floodwater retarding structure and three grade stabilization structures.
Fourth Year	One floodwater retarding structure and three grade stabilization structures.
Fifth Year	One floodwater retarding structure and three grade stabilization structures.
Sixth Year	One floodwater retarding structure and three grade stabilization structures.
Seventh Year	One floodwater retarding structure and three grade stabilization structures.

FINANCING PROJECT INSTALLATION

Cost of installing the project is $1,285,000. The Federal Government, under authority of the Watershed Protection and Flood Prevention Act, Public Law 566, as amended, will provide $829,400. Local interests, using other authorities and private funds, will provide $455,600. Availability of

financial and other assistance to be furnished by the Soil Conservation Service under Public Law 566 and other authorities depends upon appropriations made for these purposes.

Farmers cooperating with the Johnson, Nemaha and Otoe County Soil and Water Conservation Districts and the Extension Forester will establish the land treatment as shown on Table 1. Estimated cost is $301,700. Cost-sharing assistance is available under the Agricultural Conservation Program to assist in applying these practices.

Cost of technical assistance during installation of the project is $76,500. Of this, $41,900 P.L. 566 funds are needed to speed-up application of land treatment measures. The Soil Conservation Service and Forest Service will furnish technical assistance under other programs valued at $34,600.

About 160 man-days of technical assistance valued at $4,800 were furnished in 1963 under current programs. It is anticipated that this will continue through the installation period. The State of Nebraska Soil and Water Conservation Commission and the Johnson, Nemaha and Otoe County Soil and Water Conservation Districts provided part of this assistance in the past.

The estimated cost of forestry land treatment is (1) Forestation, $700; (2) Improved Forestry Practices, $1200; (3) Livestock Exclusion, $300. Individual landowners and funds from other Federal programs, such as ACP, will bear these costs of installation.

Estimated cost of technical forestry assistance is $2,000. These costs will be borne by P.L. 566, $1,000 and the State Extension Forestry Funds, $1,000.

Cost of installing structural measures is $906,800. Public Law 566 share is $787,500. Local interests will provide $119,300, plus $8,700 non-project cost for altering structures to be used as roadways.

Watershed residents have organized the Spring Creek Watershed Conservancy District under Sections 2-1550 to 2-1565, R. S. Supplement 1957 of Nebraska Statutes. Among authorities provided is the right to levy ad valorem taxes on tangible property.

The Conservancy District will use its authority to finance their share of project costs. The maximum levy provided by law will produce $3,453 annually. During the past several years a portion of the maximum levy has been in effect. Funds accumulated prior to project approval will be available for installation purposes. The District will obtain easements or fee title for all structural measures. Funds for this purpose are expected to be available from tax funds as they are needed. Most land easements and rights-of-way for grade stabilization structures are expected to be donated.

The Watershed Conservancy District may obtain funds from "the small watershed control fund" administered by the State of Nebraska through the State Soil and Water Conservation Commission to assist in acquisition of necessary land, easements and rights-of-way. Funds from this source may be used to finance a significant portion of the cost of land rights. (Sections 2-1502 and 2-1503, R. S. 1943, as amended 1963 of Nebraska Statutes).

Local sponsoring organizations and the Soil Conservation Service will develop annual plans of work. These plans will show the work to be accomplished in an orderly manner. Requests for allocation of government funds will be based upon these plans. Signing of the Project Agreement will obligate government funds for the project. These funds will become available to the Conservancy District upon partial and/or total completion of the construction contract.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Farm owners and operators will operate and maintain land treatment measures. Representatives of the Johnson County Soil and Water Conservation District will encourage owners and operators to perform needed maintenance.

Technical assistance to farm owners and operators for operating and maintaining the forestry measures beyond the installation period will be provided by the State Extension Forester in cooperation with the Forest Service under continuing forestry programs.

Structural Measures

The Spring Creek Watershed Conservancy District will operate and maintain structural measures. Representatives of the Soil Conservation Service, the Johnson County Soil and Water Conservation District, and the Spring Creek Watershed Conservancy District will make annual inspections of all structural measures. Representatives of the sponsoring local organizations will also make an inspection after each major storm or upon the occurrence of any unusual condition that might adversely affect proper functioning of the works of improvement. Reports will be prepared covering inspections, stating maintenance and repairs needed and an agreed date when repairs will be completed. This maintenance will include such items as clearing the trash rack, cleaning debris from face of dam and shoreline, repair eroded areas, controlling rodents, mowing, spraying, repairing fence, etc.

Funds, materials, and labor for carrying out operation and maintenance work will be furnished by the watershed conservancy district and individual landowners on whose property the works of improvement are located. Average annual operation and maintenance costs are $2,315 for structural measures. (Table 4).

An agreement between the Service and the Conservancy District specifying detailed operational requirements for each structural measure will be developed and signed concurrently with the signing of the first project agreement.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Spring Creek Watershed, Nebraska

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/ P.L. 566	Other	Total
Land Treatment					
Soil Conservation Service					
Cropland Treatment	Acre	7,350	-	253,000	253,000
Grassland Treatment	Acre	5,140	-	41,400	41,400
Miscellaneous Land Treatment	Acre	57	-	5,100	5,100
Technical Assistance			40,900	33,600	74,500
Subtotal - SCS			40,900	333,100	374,000
Forest Service					
Woodland Treatment	Acre	95	-	2,200	2,200
Technical Assistance			1,000	1,000	2,000
Subtotal - Forest Service		95	1,000	3,200	4,200
TOTAL LAND TREATMENT			41,900	336,300	378,200
Structural Measures					
Soil Conservation Service					
Floodwater Retarding Structures	Each	7	394,100	-	394,100
Grade Stabilization Structures	Each	21	199,500	-	199,500
Subtotal - Construction			593,600	-	593,600
Installation Services					
Soil Conservation Service					
Engineering Services			134,800	-	134,800
Other			59,100	-	59,100
Subtotal - Installation Services			193,900	-	193,900
Other Costs					
Land, Easements & R/W			-	100,900	100,900
Administration of Contracts			-	18,400	18,400
Subtotal - Other			-	119,300	119,300
TOTAL STRUCTURAL MEASURES			787,500	119,300	906,800
TOTAL PROJECT			829,400	455,600	1,285,000
SUMMARY					
Subtotal - Soil Conservation Service			828,400	452,400	1,280,800
Subtotal - Forest Service			1,000	3,200	4,200
TOTAL PROJECT			829,400	455,600	1,285,000

1/ Price Base - 1963

June, 1964

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Spring Creek Watershed, Nebraska

Measures	Unit	Total Needs	Applied to Date		Apply During Project	Remainder After Project
			Amount	Value 1/ (Dollars)		
Soil Conservation Service						
Conservation Cropping System	Acre	23,940	17,420	34,800	1,730	2,400
Contour Farming	Acre	20,775	11,115	11,100	5,485	2,085
Critical Area Planting	Acre	150	55	5,000	57	19
Diversion	Feet	33,800	30,610	3,400	-	1,600
Grade Stabilization Structure	Number	125	58	87,000	36	15
Grassed Waterway	Acre	1,950	965	144,800	595	195
Pasture Proper Use	Acre	4,642	1,100	3,300	2,380	580
Range Proper Use	Acre	2,666	705	700	1,295	330
Range Seeding	Acre	830	612	36,700	50	80
Terrace, Gradient	Feet	7,999,000	3,905,000	195,200	2,485,000	804,500
Farm Plans						
Basic Plans	Number	196	129	-	18	25
Revised Plans	Number	36	18	-	9	4
Forest Service						
Livestock Exclusion	Acre	400	20	300	40	200
Tree and Shrub Planting	Acre	80	-	-	5	20
Woodland Direct Seeding	Acre	100	-	-	5	50
Recreation Area Planting	Acre	30	-	-	10	10
Woodland Underplanting	Acre	80	-	-	5	20
Woodland Intermediate Cutting	Acre	100	30	300	7	30
Woodland Harvest Cutting	Acre	30	-	-	3	10
Woodland Thinning	Acre	70	-	-	16	20
Woodland Pruning	Acre	50	-	-	14	10
Woodland Weeding	Acre	150	-	-	20	30
Wildlife Habitat Preservation	Acre	40	-	-	10	10
Total		xxx	xxx	522,600	xxx	xxx

1/ Price Base - 1963

June, 1964

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Spring Creek Watershed, Nebraska
(Dollars) 1/

Structure Number	Installation Cost - P.L. 566 Funds				Installation Cost - Other Funds				Total Installation Cost
		Instal. Services				Other			
	Construction	Engineering	Other	Total PL 566	Construction	Admin. of Contracts	Land, Easements & R/W	Total Other	
5-A	91,200	20,700	9,100	121,000				18,000	139,000
6-A	44,900	10,200	4,500	59,600				6,600	66,200
7-B	26,000	5,900	2,600	34,500				3,600	38,100
7-C	28,600	6,500	2,900	38,000				6,500	44,500
8-A	64,100	14,600	6,400	85,100				8,700	93,800
9-A	59,100	13,400	5,900	78,400				16,700	95,100
11-A	80,200	18,200	8,000	106,400				15,900	122,300
Subtotal	394,100	89,500	39,400	523,000		9,400	66,600	76,000	599,000
2-3	9,000	2,000	900	11,900				2,400	14,300
3-1	13,400	3,100	1,300	17,800				4,700	22,500
3-2	9,700	2,200	1,000	12,900				1,000	13,900
3-3	5,200	1,200	500	6,900				1,500	8,400
4-1	7,100	1,600	700	9,400	1,100 2/			1,500	10,900
4-3	8,800	2,000	900	11,700				2,100	13,800
5-2	9,200	2,100	900	12,200				1,900	14,100
5-3	8,300	1,900	800	11,000				2,500	13,500
6-1	13,500	3,100	1,400	18,000	1,700 2/			2,400	20,400
6-2	9,800	2,200	1,000	13,000				2,300	15,300
6-4	10,200	2,300	1,000	13,500				1,700	15,200
7-1	15,900	3,600	1,600	21,100	4,400 2/			2,500	23,600
8-1	8,500	1,900	800	11,200				1,900	13,100
9-1	7,000	1,600	700	9,300				1,800	11,100
9-2	5,600	1,300	600	7,500				1,200	8,700
9-3	10,300	2,300	1,000	13,600				3,600	17,200

T le 2 Continued

Structure Number	Installation Cost - P.L. 566 Funds				Installation Cost - Other Funds				
		Instal. Services				Other			
	Construction	Engineering	Other	Total PL 566	Construction	Admin. of Contracts	Land, Easements & R/W	Total Other	Total Installation Cost
9-4	10,100	2,300	1,000	13,400				1,500	14,900
9-5	8,100	1,800	800	10,700				1,500	12,200
9-6	9,500	2,200	1,000	12,700	1,500 2/			2,000	14,700
10-1	7,700	1,700	800	10,200				1,800	12,000
11-1	12,600	2,900	1,000	16,500				1,500	18,000
Subtotal	199,500	45,300	19,700	264,500	8,700 2/	9,000	34,300	43,300	307,800
GRAND TOTAL	593,600	134,800	59,100	787,500	8,700 2/	18,400	100,900	119,300	906,800

1/ Price Base - 1963

2/ Non-project costs for altering structures to permit their use as roadways will be based on a percentage of the final contract. These percentages are as follows: 4-1, 13.4%; 6-1, 11.2%; 7-1, 21.7%; and 9-6, 13.6%.

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TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING STRUCTURES
Spring Creek Watershed, Nebraska

Item	Unit	5-A	6-A	7-B	7-C	8-A	9-A	11-A	Total
Drainage Area	sq.mi.	4.18	1.49	0.68	1.47	2.02	5.14	5.24	20.22
Storage Capacity									
Sediment	ac.ft.	408	128	54	111	121	338	400	1,560
Floodwater	ac.ft.	474	161	73	158	230	584	596	2,276
Total	ac.ft.	882	289	127	269	351	922	996	3,836
Surface Area									
Sediment Pool	ac.	56	16.2	8	17	21	47	44	209.2
Floodwater Pool 1/	ac.	105	32.0	17	35.5	46	105	95	435.5
Volume of Fill	cu.yd.	120,300	50,200	41,500	44,900	63,500	62,800	95,700	478,900
Elevation Top of Dam	ft.	1,102.0	1,154.0	1,153.0	1,153.5	1,200.0	1,196.0	1,151.5	xx
Maximum Height of Dam	ft.	40.0	39.8	35.0	31.5	32.2	36.0	42.5	xx
Emergency Spillway									
Crest Elevation	ft.	1,096.5	1,148.5	1,147.5	1,148.0	1,194.5	1,190.5	1,146.0	xx
Bottom Width	ft.	----------	----------	----------	30	----------	----------	----------	----------
Type		----------	----------	----------	Vegetated	----------	----------	----------	----------
Percent Chance of Use		----------	----------	----------	4	----------	----------	----------	----------
Ave. Curve No. - Cond. II		74	73	73	73	74	74	74	xx
Emergency Spillway Hydrograph									
Storm Rainfall	in.	5.36	5.36	5.36	5.36	5.36	5.36	5.36	xx
Storm Runoff	in.	2.66	2.57	2.57	2.57	2.66	2.66	2.66	xx
Velocity of Flow	ft./sec.	3.8	3.5	3.0	3.7	3.5	4.0	4.4	xx
Discharge Rate	c.f.s.	52	45	30	47	41	63	78	xx
Max. w.s. Elev.	ft.	1,097.6	1,149.3	1,148.2	1,149.0	1,195.4	1,191.7	1,147.3	xx
Freeboard Hydrograph									
Storm Rainfall	in.	7.84	7.84	7.84	7.84	7.84	7.84	7.84	xx
Storm Runoff	in.	4.79	4.68	4.68	4.68	4.79	4.79	4.79	xx
Velocity of Flow	ft./sec.	7.2	7.2	6.1	7.0	7.4	8.5	8.5	xx
Discharge Rate	c.f.s.	410	420	235	370	435	715	720	xx
Max. w.s. Elev.	ft.	1,099.6	1,151.5	1,149.9	1,151.0	1,197.8	1,194.7	1,150.2	xx

Table 3 Continued

Item	Unit	5-A	6-A	7-B	7-C	8-A	9-A	11-A	Total
Principal Spillway									
Capacity - Max.	c.f.s.	105	37	21.5	37	50	110	131	xx
Capacity Equivalents									
Sediment Volume	in.	1.83	1.61	1.49	1.41	1.12	1.23	1.43	xx
Detention Volume	in.	2.13	2.02	2.02	2.02	2.13	2.13	2.13	xx
Spillway Storage	in.	3.50	2.78	3.17	4.34	2.86	2.69	2.34	xx
Class of Structure		a	a	a	a	a	a	a	

1/ Crest of emergency spillway.

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TABLE 3A - STRUCTURE DATA
GRADE STABILIZATION STRUCTURES

Spring Creek Watershed, Nebraska

Site Number	Drainage Area (Acres)	Drop (Feet)	Earth Fill (Cu. Yds.)	Type of Structure
2-3	405	12.0	17,300	Drop Inlet
3-1	774	15.5	26,000	Drop Inlet
3-2	212	7.0	2,000	Drop Spillway
3-3	224	7.0	9,300	Drop Inlet
4-1	123	19.0	16,400	Drop Inlet
4-3	276	8.0	17,900	Drop Inlet
5-2	310	18.5	18,300	Drop Inlet
5-3	425	14.5	12,900	Drop Inlet
6-1	388	23.5	21,500	Drop Inlet
6-2	252	19.5	18,900	Drop Inlet
6-4	480	8.0	4,600	Drop Inlet
7-1	274	26.0	37,100	Drop Inlet
8-1	176	18.0	15,500	Drop Inlet
9-1	137	11.5	11,100	Drop Inlet
9-2	180	14.0	9,800	Drop Inlet
9-3	632	13.0	19,400	Drop Inlet
9-4	160	18.5	18,400	Drop Inlet
9-5	244	17.0	16,400	Drop Inlet
9-6	228	15.5	15,700	Drop Inlet
10-1	148	18.0	16,000	Drop Inlet
11-1	605	7.0	1,150	Drop Spillway

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TABLE 4 - ANNUAL COSTS

Spring Creek Watershed, Nebraska

(Dollars)

Evaluation Unit	Amortization of Installation Costs 1/	Operation and Maintenance 2/	Total
Floodwater Retarding Structures 5-A, 6-A, 7-B, 7-C, 8-A, 9-A, and 11-A, Grade Stabilization Structures 5-2, 5-3, 9-1, 9-2, 9-3, and 11-1	27,124	1,744	28,868
Grade Stabilization Structures			
2-3	569	35	604
3-1	895	52	947
3-2	553	38	591
3-3	334	20	354
4-1	434	28	462
4-3	549	34	583
6-1	812	53	865
6-2	609	38	647
6-4	605	40	645
7-1	939	62	1,001
8-1	521	33	554
9-4	593	39	632
9-5	485	32	517
9-6	585	37	622
10-1	478	30	508
Grade Stabilization Total	8,901	571	9,532
Grand Total	36,085	2,315 3/	38,400

1/ 1963 construction costs, amortized at 3 1/8 percent for 50 years.
2/ Long-term projected prices, 6.39 percent of construction costs.
3/ $785 - Cash cost to sponsoring local organizations.
$1,530 - Value of goods and services contributed by owners and operators of land upon whose property the works of improvement are located and the individual directors of the Spring Creek Watershed Conservancy District.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Spring Creek Watershed, Nebraska

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	33,780	13,040	20,740
Other Agricultural	4,050	1,570	2,480
Nonagricultural			
Road and Bridge	14,320	3,640	10,680
Subtotal	52,150	18,250	33,900
Erosion			
Floodplain Scour	1,900	680	1,220
Gullies	5,290	0	5,290
Subtotal	7,190	680	6,510
Indirect	5,830	2,070	3,760
Total	65,170	21,000	44,170

1/ Price base, long-term projected.

June, 1964

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES
Spring Creek Watershed, Nebraska
(Dollars) 1/

Evaluation Unit	Average Annual Benefits					Average Annual Cost	Benefit Cost Ratio
	Flood Prevention						
	Damage Reduction	Changed Land Use	Secondary	Conservation Treatment Benefits	Total		
Floodwater Retarding Structures 5-A, 6-A, 7-B, 7-C 8-A, 9-A, and 11-A; Grade Stabilization Structures 5-2, 5-3, 9-1, 9-2, 9-3 and 11-1	31,153	1,000	2,770	3,517	38,440	28,868	1.3:1
Grade Stabilization Structures							
2-3	118			644	762	604	1.3:1
3-1	-			991	991	947	1.0:1
3-2	319			461	780	591	1.3:1
3-3	58			594	652	354	1.8:1
4-1	563			324	887	462	1.9:1
4-3	542			927	1,469	583	2.5:1
6-1	912			956	1,868	865	2.2:1
6-2	637			335	972	647	1.5:1
6-4	195			473	668	645	1.0:1
7-1	991			1,182	2,173	1,001	2.2:1
8-1	233			636	869	554	1.6:1
9-4	236			596	832	632	1.3:1
9-5	147			583	730	517	1.4:1
9-6	302			450	752	622	1.2:1
10-1	524			707	1,231	508	2.4:1
Subtotal	5,777			9,859	15,636	9,532	1.6:1
Grand Total	36,930 2/	1,000	2,770	13,376	54,076	38,400	1.4:1

1/ Price Base - Benefits are long-term projected. Costs, See Table 4, Footnotes 1 and 2.
2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $7,240 annually.

INVESTIGATIONS AND ANALYSES

Hydraulic and Hydrologic Investigations

Hydraulic and hydrologic investigations were made primarily to determine runoff characteristics which are expected to take place before and after the conditions of this plan have been fulfilled.

Since there are no measured stream flows in this watershed, surface runoff is based upon procedures described in the Hydrology Handbook, Supplement A. This method considers three variables: rainfall, antecedent moisture condition, and the hydrologic soil-cover complex.

Rainfall was based upon precipitation amounts as published in United States Weather Bureau Technical Paper Number 40 and other Weather Bureau published data (Tecumseh station). A partial-duration synthetic-storm series was developed based upon three damaging storms per year.

Hydrologic soil-cover complex numbers show the effect soil type, land use, and land treatment have on runoff. An average antecedent moisture condition was used.

The watershed was divided into nine areas to compute soil-cover complex numbers. The weighted average for present conditions is 76. With the proposed land treatment measures applied, the average is 74. The inventory of soils and land uses, from soil survey maps and estimates of conservation applied and to be applied during the project period, were used in making the analysis.

The watershed was divided into 34 sub-watershed areas. Unit hydrographs were developed for each sub-watershed based on storm durations typical to the area.

Area inundated by depth increments was based on 21 cross sections. The relationship of acres inundated to discharge rates was based on a synthetic storm series.

Relation of volume runoff to discharge was developed by floodrouting using Wilson's method. Floodrouting determined the discharge for the unit volume of runoff for each cross section.

The following conditions were evaluated:

1. Current watershed conditions.
2. Watershed conditions with project land treatment applied.
3. Watershed conditions with project land treatment and floodwater retarding structures installed. Several structural systems were studied.

Storage requirements were based on Technical Release Number 10.

Floodwater retarding structure release rates were established considering downstream channel capacities and economics of floodwater storage. Individual structure release rates are shown on Table 3.

Emergency spillways' dimensions were determined by floodrouting the emergency spillway and the freeboard hydrographs by the method outlined in Lincoln E&WP Unit Hydrologic Procedure Number 2. Emergency spillways will meet minimum criteria, as established by the State of Nebraska

Geologic Investigations

Preliminary geologic investigations were made at all proposed sites. These investigations included studies of geologic formations, topography, borrow areas, spillways and stream channels.

Investigations of four sites were made by the use of a truck-mounted auger, a hand auger, and observing. Information was obtained from the investigations to estimate seepage problems, availability of borrow material, location of emergency spillways, and other factors that would affect cost of structures.

Geologic formations in general are:

Peorian Loess	Pleistocene System
Grand Island Formation	Pleistocene System
Council Grove Group	Permian System
Admire Group	Permian System
Waubansee Group	
Richardson Subgroup	Pennsylvanian System

A limestone belonging to the Richardson subgroup crops out in the stream channel along the south side of section 6, township 5 north, range 12 east. This limestone forms an overfall about ten feet. Shale overlies the limestone and is exposed in the stream bank at the same location. Rocks of the Permian System are not exposed within the watershed. The Pennsylvanian and Permian formations were covered by glacial till and later the till was covered with Peorian loess; therefore, construction of dams will be from till with some loess materials. A pre-glacial channel crosses approximately in the center of the watershed; however, it will not affect the construction or functioning of the structures.

The geologic conditions at each site are described on form SCS-375, "Preliminary Geologic Investigation of Dam Sites." Detailed investigations and laboratory testing will be accomplished prior to construction of the structures.

Floodplain Damage Investigations

A detailed investigation of floodplain damages was made by using a hand probe and making observations along or near each hydrologic cross section. The damages mapped were expanded the distance represented by that cross section. Percent damage per depth of scour or deposits was based on recommendations of the State Conservation Agronomist.

Damage reduction for floodplain scour was based on decreased depth of flooding reduction. Sediment damage reduction was based on the reduced area and frequency flooded and the reduction of available sediment.

Sedimentation Investigations

Sediment-storage requirements for floodwater retarding structures were calculated by using the Musgrave formula in accordance with Engineering Memorandum, Nebraska No. 9. Soil classifications were taken from soils maps. Land slopes, length of slope, and present land use were obtained by field surveys. Estimates of future land use were based on the conservation needs study.

Principal spillway elevations on drop inlet type grade stabilization structures are located to protect overfalls and/or to furnish a stable outlet for land treatment measures. In most instances, a sediment-storage area is created that exceeds that needed for a 25-year sediment pool. Allowances were made, however, for sediment storage within the flood pool equaling 25 percent of 25 years expected sediment.

Economic Investigations

Determination of Damages

Interviews with local farmers and Soil Conservation Service technicians familiar with the watershed form the basic data used in the evaluation of agricultural damages. Publications of other agencies pertaining to crop yields, acreages, costs, and prices of agricultural products supplemented this information.

Estimates of normal flood-free crop yields were adjusted to allow for expected yield increases resulting from advances in technology. The adjustments were based on the assumption that management and production practices now used by the better farmers would be in general use over the life of the project. The following table shows the present cropping pattern, typical adjusted yields and the composite gross value per acre of Spring Creek floodplain.

Gross Value of Composite Floodplain Acre

Crop	Flood-Free Yields	Long-Term Projected Prices	Percent Distribution	Gross Value
Corn	75 Bu.	$ 1.39	34	$35.45
Wooded Pasture	1.5 AUM	2.80	34	1.45
Wheat	40 Bu.	1.60	11	7.05
Milo	85 Bu.	1.25	9	9.55
Tame Pasture	4.5 AUM	2.33	4	.40
Soybeans	40 Bu.	2.25	3	2.70
Alfalfa and/or Clover	4.5 Ton	16.10	3	2.15
Miscellaneous	-	-	2	-
Total			100	$58.75

The 100-year synthetic series method was used in evaluating floodwater damage to crops and pastures. Area inundated by the various frequency storms was derived from stage-area inundated curves. The value of the undamaged composite acre was adjusted to allow for lower values in those areas affected by scour damage. The crop damage rate was determined as the value of reduced crop yields and adjusted to allow for any increase or decrease of production expenses. These damage rates were computed for various depths of inundation by months, then weighted by the percent of excessive storms that occur in each month. The weighted rates were multiplied by acreages

inundated by selected discharges. A dollar damage versus discharge curve was developed to provide a monetary value for each storm in the 100-year storm series.

Other agricultural damage (such as floodwater damage to fences, farm buildings, livestock, and clean-up of debris) was determined from an analysis of damage schedules and additional interviews. This damage was 12 percent of crop and pasture damage.

Data used in the evaluation of roads and bridges were obtained from county road officials. Annual damage to bridges in close proximity to structures was evaluated by comparing replacement costs and length of life with and without the project. The effectiveness of the structures will allow this reduction without increasing the hazard of future floods. Dollar damage versus discharge curves were developed for bridges located further downstream. Estimated benefits to these bridges will accrue from a reduced maintenance cost. Damage to roads was related to length of road flooded and the estimated replaceeent costs for road fill and gravel.

The estimated monetary value of the physical damage to the floodplain from erosion was based on the value of the production lost, taking into account the lag in recovery of productivity and the cost of farm operation to speed recovery. Damage was related to depth of flooding, with weight given to increased velocity from the deeper flows.

Damage from gully erosion was based on production lost when land is voided or depreciated. The physical land damages in an average annual rate, as determined by the geologist, were multiplied by the monetary values of such damage as calculated by methods outlined in Chapter V, Economics Guide. Additional monetary damages were also assigned to other types of property such as roads, bridges, fences and livestock water wells.

Indirect damages were estimated at 10 percent of the agricultural damages and 15 percent of the nonagricultural damages. This damage includes interruption of and extra travel due to road damage; interruption of public utility services; inconveniences and hardships in repairing and replacing equipment, supplies, and materials damaged by floods; and loss of business income.

Benefits from Reduction of Damages

Average annual damages were calculated for conditions without a project, with land treatment installed, and after installation of the complete project. The difference between the damages at the time of initiation of each project increment and that expected after its installation constitutes the damage reduction benefits brought about by that increment.

Benefits from reduction of crop and pasture damages and floodplain scour resulted from the combined effect of reduction in area inundated and reduced depth of inundation.

Changed Land Use Benefits

Farmers in the floodplain were asked what changes in land use might be expected if floods were reduced in extent and frequency. Their responses

indicated that some floodplain areas, now in woody pasture, will be cleared and farmed more intensively after the hazards of flooding are reduced. Areas to be cleared are in evaluation reaches where project installation has reduced flooding to a four-year frequency or greater and/or reduced the acres inundated at a four-year frequency storm event by more than 50 percent. The benefits per acre reflect the estimated change in net income, less development costs and damages of higher value use. Benefits were discounted five years following project installation to reflect a lag in time for benefits to accrue.

Conservation Treatment Benefits

The technical guides for Johnson County Soil and Water Conservation District require that a grassed waterway or outlet channel be established for all gradient terraces and that the area between terrace ridges be contour farmed. The guides require a stable outlet as a prerequisite to establishment of grassed waterways. Interviews with local Soil Conservation Service technicians and SWCD supervisors reveal that in many areas of the watershed terraces and stable grassed waterways cannot be installed because of unstable outlet conditions.

Benefits from this source were measured as the difference in net income under improved management as opposed to net income under ordinary management. For each type of management all production and overhead costs were deducted to arrive at net income. Crop yield information was obtained on bench mark soils from Standard Soil Survey data. Land treatment installation and maintenance costs were determined by analyzing the watershed conservation needs information. These costs were converted to an annual figure and deducted as associated costs.

The annual net return per acre was applied to portions of each drainage area where the installation and/or maintenance of land treatment measures would be difficult without first installing base grade stabilization structures.

Appropriate discounting at a 3 percent interest rate was applied to areas that are now treated but will be affected in future years. Portions of the drainage areas above certain road structures (corrugated metal or concrete tubes or boxes) and existing Public Law 46 structures were not included.

Secondary Benefits

Secondary benefits to structural measures were computed in accordance with Watersheds Memorandum SCS-57. The value of local secondary benefits stemming from the project were considered to be 10 percent of the direct primary structural benefits. These benefits, which accrue within the immediate zone of influence of the project, are from the transporting, processing, and marketing of those goods and services that produce the primary structural benefits.

Appraisal of Land and Easement Values

Cost per acre of land, easements, and rights-of-way reflects sponsors' estimates. Landlord's net return was analyzed and the resulting value was

capitalized. It compared favorably to the sponsors' estimate. Cost per acre of areas encroached on by structure sites and sediment pools was considered to be 100 percent of the estimated market value. Cost of necessary easements for flood storage was considered to be 50 percent of the estimate.

Price Base

Long-term prices, as projected by ARS and AMS, were used for benefit determinations. These prices are from "Agricultural Price and Cost Projections," dated September, 1957. Cost of land treatment measures, technical assistance, and structural works of improvement are estimated at 1963 price levels. Installation costs were amortized at three and one-eighth percent interest for 50 years.

Operation and Maintenance

Operation and maintenance cost for floodwater and grade stabilization structures was estimated at .39 percent of construction cost.

Details of Methodology

Details of the procedures used in the evaluation are described in the Soil Conservation Service Economics Guide for Watershed Protection and Flood Prevention, March, 1964.

Engineering Investigations

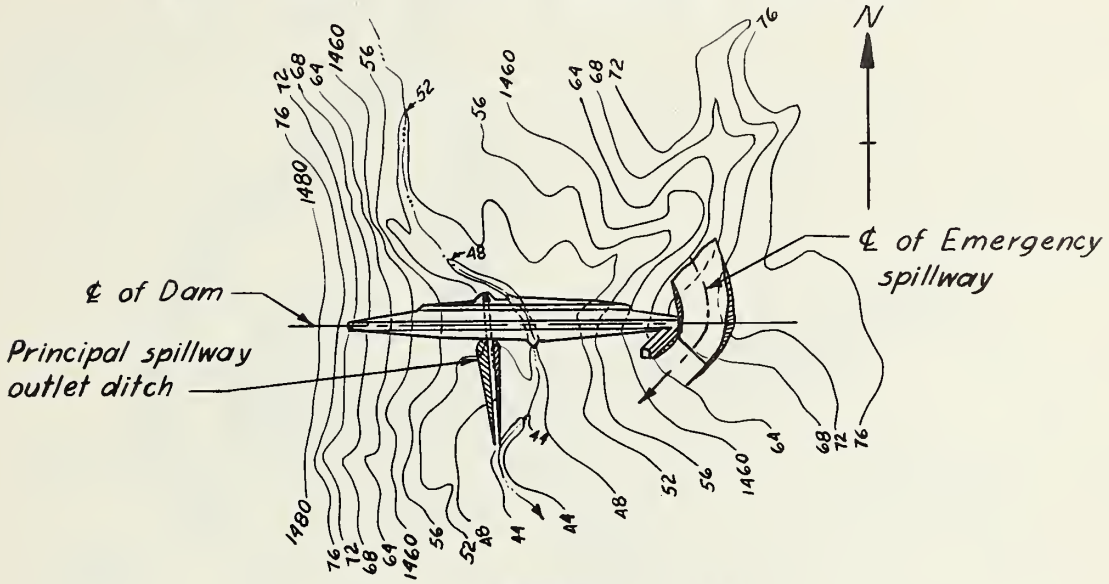
Preliminary designs and cost estimates were made for the floodwater and grade stabilization structures. Cross sections, profiles, and topography are based on sea level datum.

Storage volume includes capacity for submerged sediments below the principal spillway elevation.

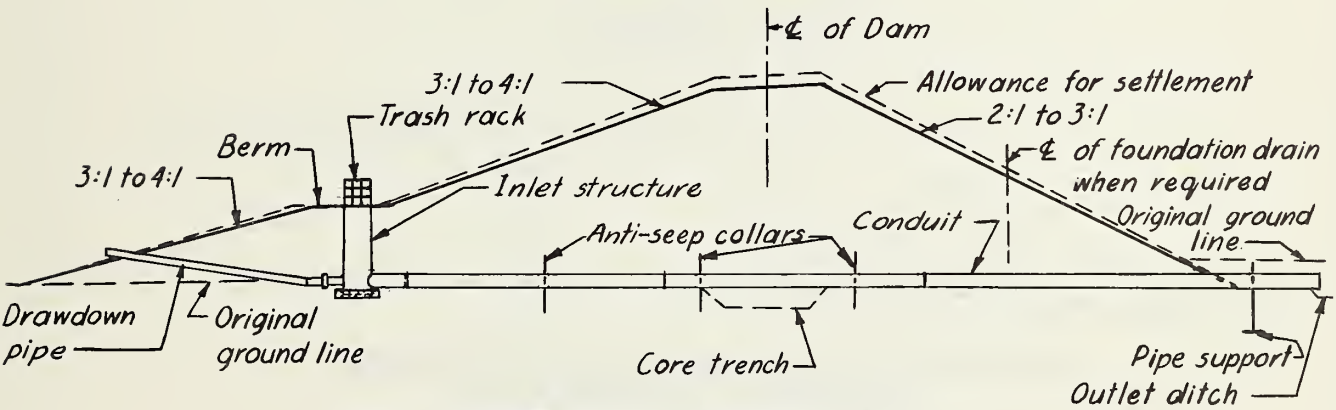
Design velocity of the emergency spillways is based upon the erosive characteristics of the soil at the site. Structural classification and design of the principal and emergency spillways are based upon criteria established in Washington Engineering Memorandum 27, dated March 14, 1958. Amounts of rainfall from Atlases derived from U. S. Weather Bureau Technical Paper Number 40 were used in the routing of the emergency spillways. The size of the emergency spillways exceeds the requirements established in Washington Memorandum No. 31, Rev. April 2, 1959.

Twenty-eight land stabilization problem areas were investigated to determine the seriousness of the problem and to explore its physical and cultural limitations. Engineering surveys were made on 23 of these problem areas.

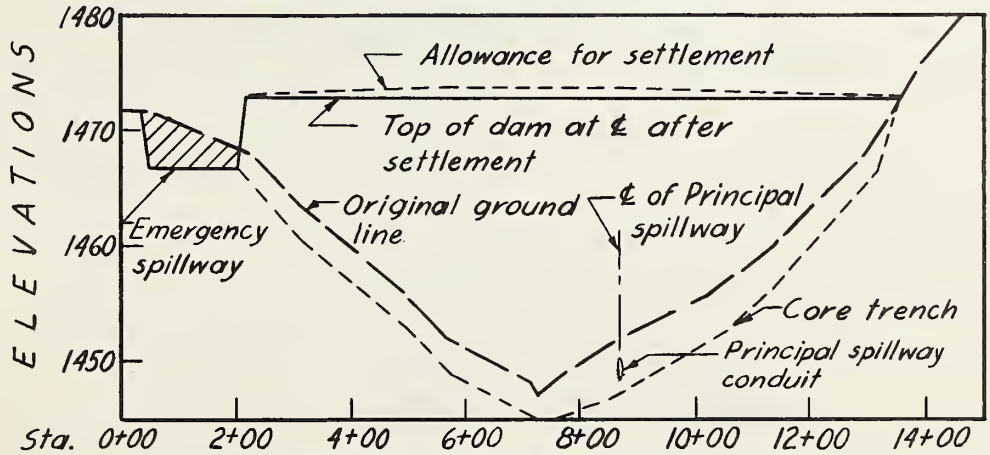
TYPICAL FLOODWATER RETARDING STRUCTURE WITH SINGLE STAGE PRINCIPAL SPILLWAY



GENERAL PLAN



CROSS SECTION OF DAM ON CENTERLINE OF SINGLE STAGE PRINCIPAL SPILLWAY



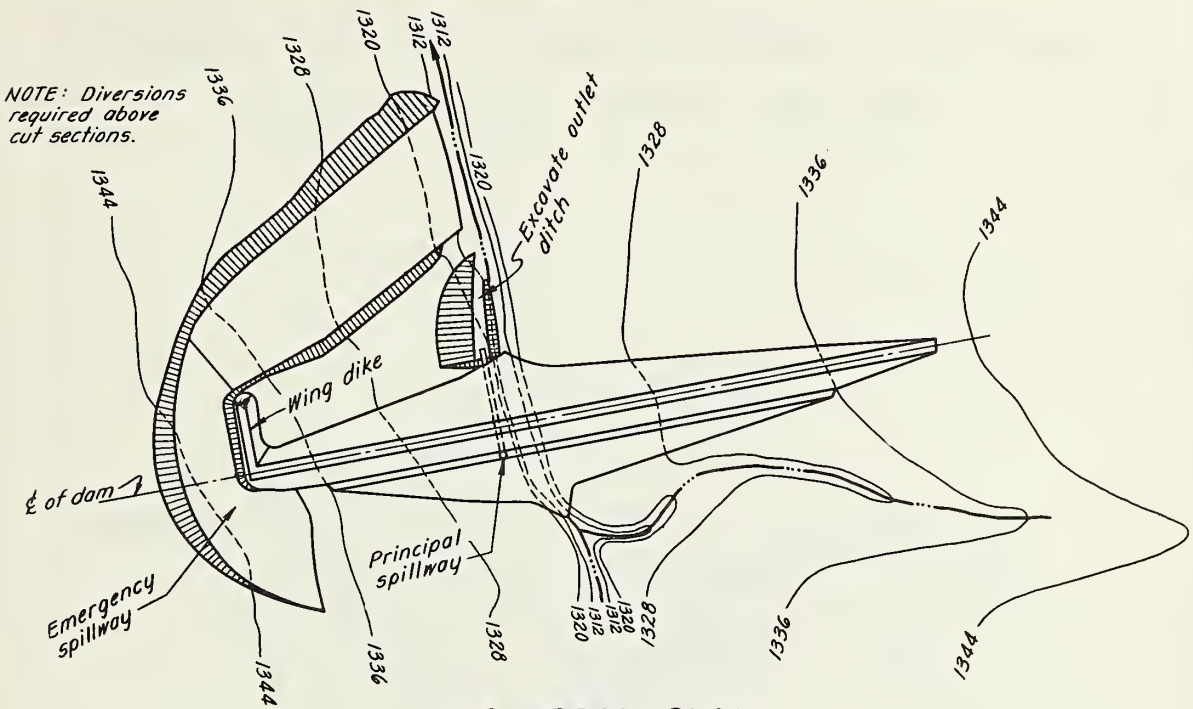
PROFILE ON CENTERLINE OF DAM

USDA-SCS

Rev. 2-64 5,L-15,520

Figure 1

TYPICAL STABILIZING AND SEDIMENT CONTROL STRUCTURE



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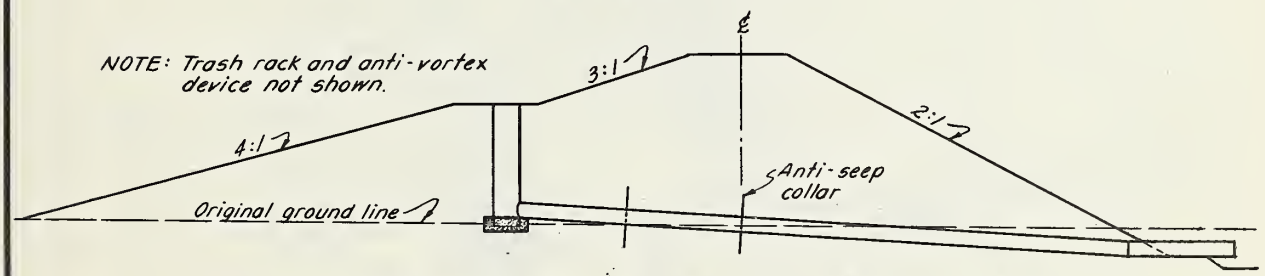
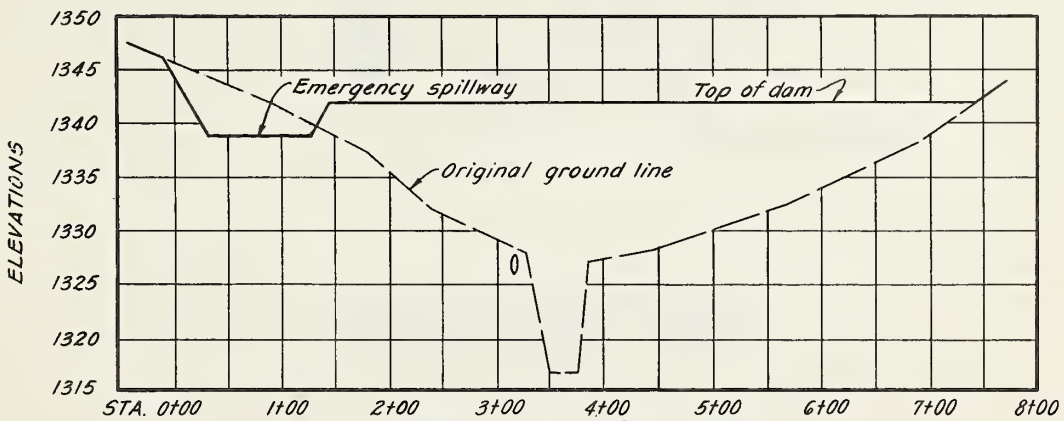


CROSS SECTION OF DAM ON CENTERLINE OF PRINCIPAL SPILLWAY



PROFILE ON ℄ OF DAM

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

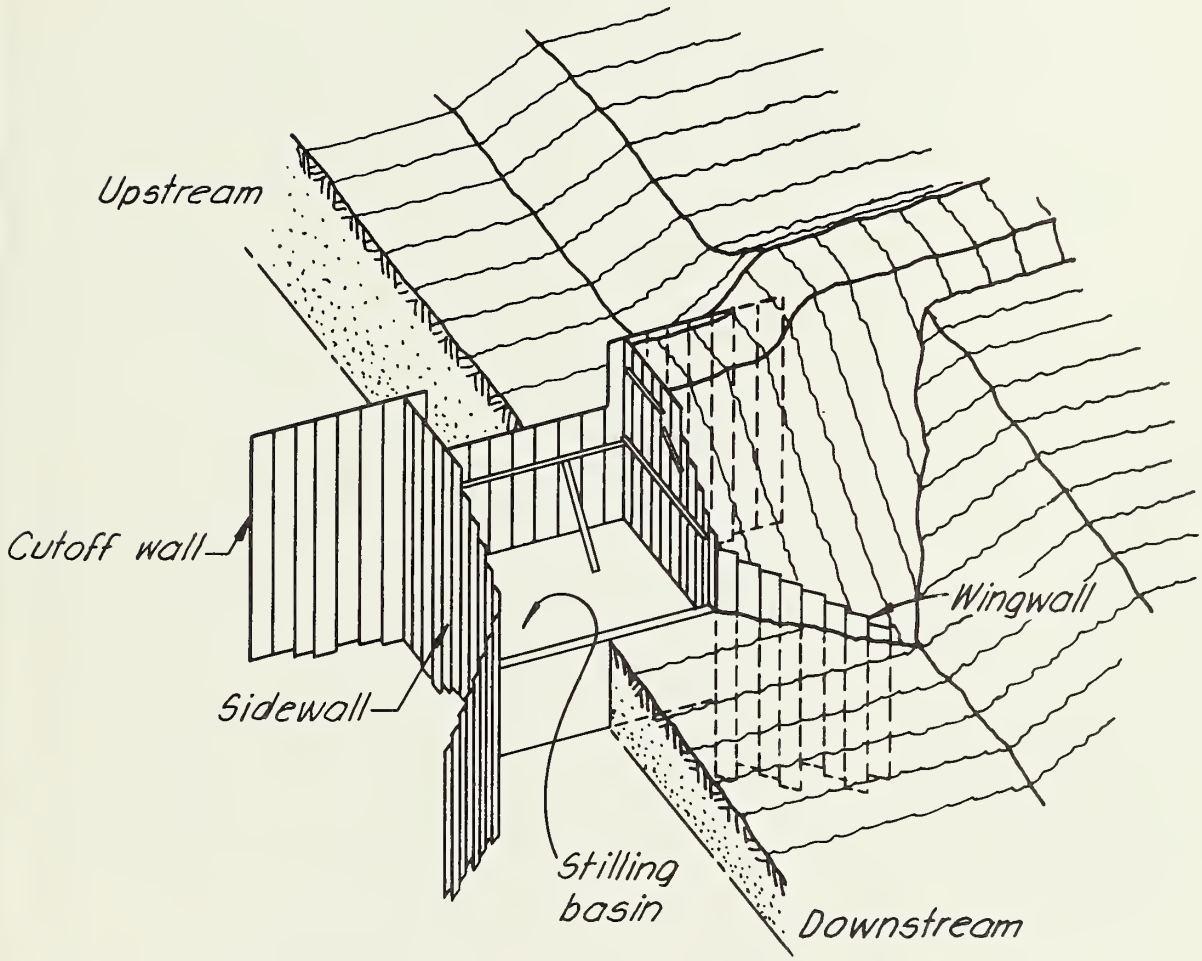
USDA-SCS-LINCOLN NEBR 1964

S. L - 20,426

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TYPICAL GRADE STABILIZATION STRUCTURE

SHEET PILING DROP SPILLWAY



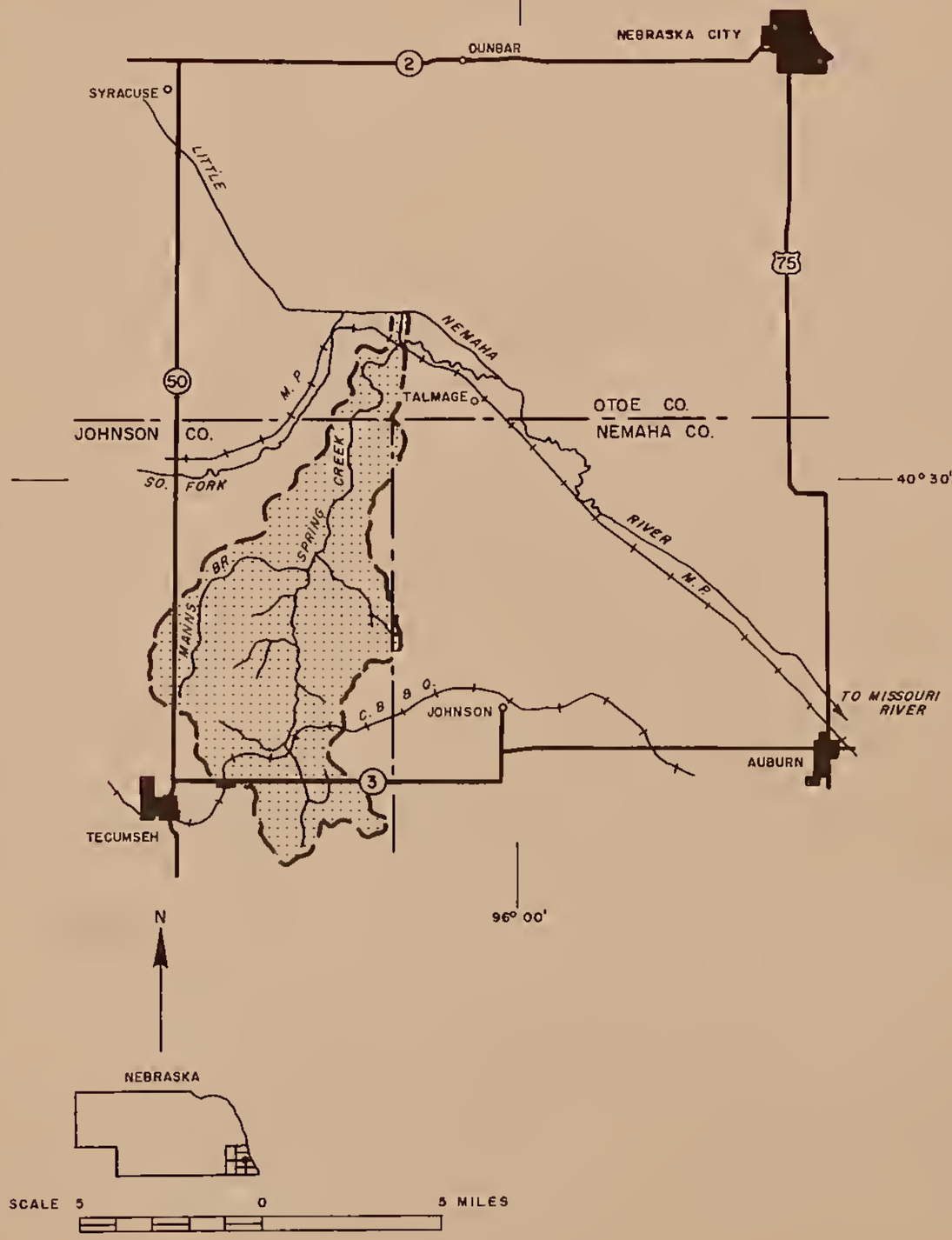
PERSPECTIVE VIEW

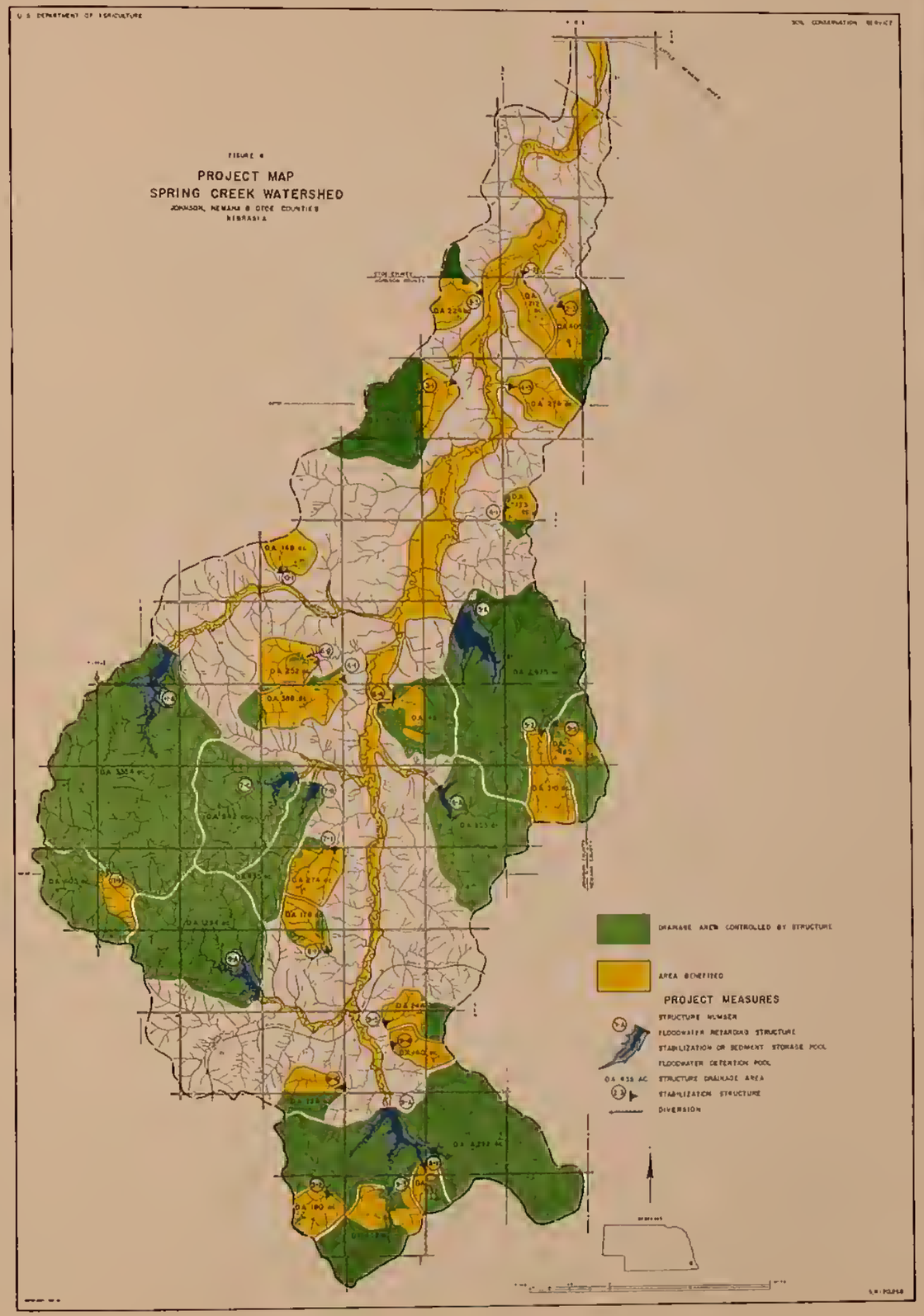
Figure 3

USDA-SCS-LINCOLN, NEBR 1963

5,L-19,677

PROJECT LOCATION MAP





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